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# Fruit and vegetable consumption among migrants in Switzerland

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## Abstract

**Objective:** To assess the relative risk of low daily fruit and vegetable consumption for six large migrant groups in Switzerland.

**Design:** Cross-sectional health survey carried out 2007 (Swiss Health Survey) and 2010 (Swiss Migrant Health Survey) in Switzerland. Multinomial logistic regression models were used to estimate relative risk rates (RRR) of migrants relative to Swiss nationals.

**Setting:** Data obtained from representative samples of Swiss and foreign nationals living in Switzerland.

**Subjects:** A random sample ( $n$  14 637) of the Portuguese, German, Italian, Turkish, Serbian, Kosovan and Swiss permanent resident adult population (17–64 years old) was interviewed.

**Results:** The proportion of participants who adhered to the recommended fruit and vegetable consumption was below one-third in all study populations. Compared with Swiss nationals, the relative risk of low daily fruit and vegetable intake relative to recommended intake was higher in Turkish nationals (RRR = 2.92, 95% CI 1.91, 4.48;  $P$  = 0.0000) and Kosovan nationals (RRR = 4.76, 95% CI 3.01, 7.55;  $P$  = 0.0000). The respective relative risks of Portuguese, Serbian, German and Italian nationals were not significantly different from the Swiss reference group.

**Conclusions:** Initiatives for the promotion of fruit and vegetable consumption should continue to address the population at large. At the same time, programmes that are tailored to the specific needs of migrants from Turkey and Kosovo should be considered.

**Keywords**  
Diet  
Fruit  
Vegetable  
Migrant  
Switzerland

Non-communicable diseases, especially CVD, cancer, obesity and type 2 diabetes mellitus, currently kill more people every year than any other cause of death. Fruit and vegetables are an important component of a healthy diet and, if consumed daily in sufficient amounts, could help prevent major diseases such as CVD and certain cancers<sup>(1)</sup>.

Several studies have found associations between a higher intake of fruit and vegetables and a reduced risk of CVD mortality<sup>(2–8)</sup>. Similarly, a higher daily intake of fruit and vegetables is associated with a reduced risk of some types of cancer<sup>(9–14)</sup>.

In 2001, the Swiss Cancer League, supported by the Swiss Federal Office of Public Health and Health Promotion Switzerland started an ongoing prevention campaign 'Five servings of fruit and vegetables a day' in order to promote an adequate daily consumption of fruit and vegetables among the population of Switzerland. In 2007, 29.3% of the Swiss population aged 15 years and older reported to consume the recommended five portions daily<sup>(15)</sup>. Comparably little is known about the factors that are associated with fruit and vegetable consumption in

Switzerland. There is some evidence that women and older age cohorts have a higher propensity to consume fruit and vegetables compared with men and younger age cohorts<sup>(15,16)</sup>. To our knowledge, no population-based study so far has assessed the fruit and vegetable consumption of adult migrants in Switzerland, despite the fact that migrants accounted for 1.7 million people or 22% of the permanent resident population of Switzerland in 2009<sup>(17)</sup>. Migrants are an important group and prevention campaigns may need to be tailored to specific migrant groups and their needs. A large body of literature on migration and health suggests that cultural patterns shape physical activity, body images, dietary intake and food preferences<sup>(18–24)</sup>. However, the evidence on dietary patterns is mixed<sup>(25)</sup>. While some studies report that migrant status is associated with a low daily intake of fruit and vegetables or adverse dietary patterns<sup>(26,27)</sup>, others report that migrant status is associated with a higher daily intake or beneficial dietary patterns compared with the native population of the host country<sup>(28–32)</sup>. Given that the mixed evidence partially reflects culture-specific dietary practices as well as acculturation to the dietary

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practices of the host countries, we may expect different patterns of fruit and vegetable consumption among migrants in Switzerland as well. The aim of the present study was to assess the risk of low daily intake of fruit and vegetables among six large migrant groups in Switzerland and thereby serve as a guide for effective fruit and vegetable promotion interventions.

## Methods

### Study design

The study is a population-based cross-sectional health survey carried out in 2007 and 2010 in Switzerland. Ethical approval for the study was not required.

### Study population and data

Data from the 2010 Swiss Migrant Health Survey (SMHS) and the 2007 Swiss Health Survey (SHS) were obtained from the Swiss Federal Office of Public Health ([www.bag.admin.ch](http://www.bag.admin.ch)). The SMHS is a cross-sectional, population-based telephone survey which intends to monitor health trends in a representative sample of migrants and has been carried out in 2004 and 2010 so far. Due to economic constraints, the SMHS is limited to a selected number of nationalities. The core study population in 2010 comprised permanent residents from Portugal, Turkey, Serbia and Kosovo ( $n$  1800). Participants aged 17–74 years were chosen by stratified random sampling (gender, country of birth, duration of stay) from the database of the central immigration information system. The computer-aided telephone interviews were carried out in Portuguese, Turkish, Serbian, Albanian, German and French. Data on Swiss, German and Italian nationals from the 2007 SHS were pooled with the 2010 SMHS data. The SHS was first conducted in 1992 and is repeated every five years. The 2007 sample included over 19 000 participants aged 15 years or older. Participants were randomly selected within private households and computer-aided telephone interviews were conducted in German, French and Italian. People who did not speak any of these languages or people who had insufficient language skills were excluded from the SHS.

The pooled sample represents 58.2% of the migrant population as well as nationals from Switzerland. Of the 1.7 million migrants in Switzerland, 17.0% are Italian, 14.9% are German, 12.0% are Portuguese, 5.4% are French, 3.6% are Spanish, 6.9% are Serbians, 4.1% are Turkish and 3.3% are Kosovan<sup>(33)</sup>. Migrants from France and Spain were not included because of their small sample size in the SHS. Since all interviews of participants in the pooled sample were conducted in their respective native language, selection bias due to insufficient language skills has been mitigated; i.e. the selection process is less likely to favour migrants who are well-integrated, well-educated and have been living in Switzerland for a long period of time.

For the purposes of the present study, the initial pooled sample was further narrowed down to include only those aged 17–64 years because only a few migrants in the SMHS sample were over 64 years old. The total sample size amounts to 14 637. The sample size by nationality and further characteristics of the pooled SMHS and SHS sample is shown in Table 1.

### Target outcome, predictor and covariates

Daily fruit and vegetable intake (FVI), the target outcome of the study, was derived from self-reported data. Participants were asked to estimate their average daily consumption of fruit by answering the question: 'How many servings of fruit and fruit juice do you have on average per day? One serving corresponds to the size of your fist (approximately 120 g). In the case of fruit juice, one serving corresponds to a medium size glass'. Similarly, a question relating to the average consumption of vegetables was asked: 'How many servings of vegetable and vegetable juice (without potatoes or sweet corn) do you have on average per day? One serving corresponds to the size of your fist (approximately 120 g). In the case of vegetable juice, one serving corresponds to a medium size glass'. The choice of answers included: (i) 'none'; (ii) 'less than 1 serving per day'; (iii) '1–2 servings per day'; (iv) '3–4 servings per day'; and (v) '5 or more servings per day'. FVI was calculated by adding up the self-reported frequency of fruit and vegetable consumption<sup>(15)</sup>. Participants were then assigned to the following three categories: (i) recommended FVI ( $FVI \geq 5$  servings of fruit and vegetables/d)<sup>†</sup>; (ii) medium FVI ( $2 \leq FVI < 4$ ); and (iii) low FVI ( $0 \leq FVI < 2$ ). Although these questions have been used before<sup>(15,16,34)</sup>, the construct and content validity of this instrument have not been formally assessed so far. We conducted a linguistic validation process that included a conceptual analysis of all original instruments in collaboration with the translators, as well as forward and backward translations and a review of the backward translation.

For the primary predictor, the country of origin, the following were considered: Portugal, Turkey, Serbia, Kosovo, Germany, Italy and Switzerland. Double citizens who acquired Swiss nationality through naturalization were considered Swiss. Covariates included: age, gender, socio-economic status (SES) and dwelling zone (rural/urban). SES comprised three indicators: education (basic, secondary and university), employment (economically active, no/yes) and housing situation (rooms per person).

\* For the summation process the following values were assigned to the categories: 0 = 'none'; 0.5 = 'less than 1 serving per day'; 1.5 = '1–2 servings per day'; 3.5 = '3–4 servings per day'; and 5 = '5 or more servings per day'.

† The category 'recommended FVI' reflects the amount of daily fruit and vegetable intake which is currently promoted by the Swiss Federal Office of Public Health ([http://www.bag.admin.ch/themen/ernaehrung\\_bewegung](http://www.bag.admin.ch/themen/ernaehrung_bewegung)) and the Swiss Cancer League.

**Table 1** Frequency distribution and central tendency for variables in the sample of participants aged 17–64 years by nationality (2010 Swiss Migrant Health Survey 2010 and 2007 Swiss Health Survey)\*

|                                      | Portugal |         |         | Turkey  |         |         | Serbia  |         |         | Kosovo  |         |         | Germany |         |         | Italy   |         |         | Switzerland |         |         |
|--------------------------------------|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------------|---------|---------|
|                                      | n        | or mean | % or sd | n       | or mean | % or sd | n       | or mean | % or sd | n       | or mean | % or sd | n       | or mean | % or sd | n       | or mean | % or sd | n           | or mean | % or sd |
| (n 14 637)                           | (n 449)  |         |         | (n 644) |         |         | (n 455) |         |         | (n 648) |         |         | (n 324) |         |         | (n 369) |         |         | (n 11 748)  |         |         |
| Sample size                          |          |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |             |         |         |
| Fruit and vegetable consumption (%)† |          |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |             |         |         |
| 0–2 servings/d                       | 43       | 9.6     | 23.2    | 149     | 23.2    | 62      | 13.8    | 195     | 30.6    | 27      | 8.4     | 38      | 10.7    | 837     | 7.3     |         |         |         |             |         |         |
| 2–4 servings/d                       | 279      | 62.3    | 56.6    | 364     | 56.6    | 279     | 62.0    | 310     | 48.7    | 196     | 61.3    | 227     | 64.2    | 7130    | 62.5    |         |         |         |             |         |         |
| ≥5 servings/d                        | 126      | 28.1    | 20.2    | 130     | 20.2    | 109     | 24.2    | 132     | 20.7    | 97      | 30.3    | 89      | 25.1    | 3441    | 30.2    |         |         |         |             |         |         |
| Age (years)                          | 35.6     | 12.2    | 10.5    | 33.8    | 10.5    | 33.3    | 12.4    | 29.0    | 10.7    | 40.8    | 10.7    | 43.1    | 11.9    | 43.0    | 13.0    |         |         |         |             |         |         |
| Gender (%)                           |          |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |             |         |         |
| Male                                 | 225      | 50.1    | 50.0    | 322     | 50.0    | 227     | 49.9    | 322     | 49.7    | 168     | 51.9    | 204     | 55.3    | 5390    | 45.9    |         |         |         |             |         |         |
| Female                               | 224      | 49.9    | 50.0    | 322     | 50.0    | 228     | 50.1    | 326     | 50.3    | 156     | 48.1    | 165     | 44.7    | 6358    | 54.1    |         |         |         |             |         |         |
| Education (%)                        |          |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |             |         |         |
| Basic                                | 251      | 55.9    | 40.2    | 259     | 40.2    | 139     | 30.6    | 303     | 46.8    | 5       | 1.5     | 92      | 24.9    | 868     | 7.4     |         |         |         |             |         |         |
| Secondary                            | 166      | 37.0    | 38.2    | 246     | 38.2    | 256     | 56.4    | 323     | 49.8    | 122     | 37.7    | 228     | 61.8    | 7463    | 63.5    |         |         |         |             |         |         |
| University                           | 32       | 7.1     | 21.6    | 139     | 21.6    | 59      | 13.0    | 22      | 3.4     | 197     | 60.8    | 49      | 13.3    | 3415    | 29.1    |         |         |         |             |         |         |
| Economically active (%)              | 369      | 82.2    | 53.0    | 341     | 53.0    | 341     | 75.0    | 387     | 59.9    | 286     | 88.3    | 277     | 75.1    | 9364    | 79.7    |         |         |         |             |         |         |
| Housing situation (rooms/person)     | 1.1      | 0.6     | 0.5     | 1.2     | 0.5     | 1.1     | 0.4     | 0.9     | 0.4     | 2.1     | 1.0     | 1.8     | 1.0     | 2.0     | 1.0     |         |         |         |             |         |         |
| Dwelling zone (%)‡                   |          |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |             |         |         |
| Urban dweller                        | 351      | 78.2    | 88.5    | 570     | 88.5    | 375     | 82.4    | 484     | 74.7    | 248     | 76.5    | 308     | 83.5    | 7751    | 66.0    |         |         |         |             |         |         |
| Rural dweller                        | 98       | 21.8    | 11.5    | 74      | 11.5    | 80      | 17.6    | 164     | 25.3    | 76      | 23.5    | 61      | 16.5    | 3997    | 34.0    |         |         |         |             |         |         |

\*Data refer to the number of participants and percentage or arithmetic mean and standard deviation within nationality.

†One serving corresponds to approximately 120 g. In the case of juice, one serving corresponds to a medium size glass, approximately 150 ml.

‡Classification according to the Swiss Federal Statistical Office<sup>(61)</sup>. Urban areas include isolated cities (≥10 000 inhabitants) and urban agglomerations (≥20 000 inhabitants).

## Missing data

Missing data were generally rare on all variables. For the predictor and two covariates, no data were missing and for the remaining covariates 0.5% or less of the data were missing within each nationality. Missing data on FVI, the dependent variable, amounted to 2.6% and there were no substantial differences in the amount of missing data between nationalities. Overall, 3% of the data were missing. Our analysis of missing-value patterns also revealed no systematic relationships between FVI and the predictor or the covariates. We therefore assumed that the data were missing completely at random and applied list-wise deletion which gives valid inferences under this assumption<sup>(35)</sup>.

## Weighting

The original expansion weights of the SMHS and SHS were used for all population estimates. The weights take into account the different sampling strategies which have been used to sample migrants and Swiss nationals and they allow correct estimates of population parameters for migrants and Swiss nationals.

## Statistical analysis

We used the STATA statistical software package version 11.2 for all statistical analyses. We report relative risk ratios (RRR) for different nationalities from multinomial logistic regression models (mlogit) adjusting for age, gender, SES and dwelling zone. We also report corresponding 95% confidence intervals and *P* values. To incorporate information on the appropriate weights and sampling units for correct variance estimation, all statistical analyses were carried out using STATA's command for complex surveys (svy prefix). Statistical significance was established at  $P \leq 0.05$ .

## Results

We found different prevalence rates of low, medium and recommended FVI between migrants and nationals of Switzerland (Table 2): 30.3% (95% CI 29.2, 31.3) of Swiss nationals adhered to the recommended FVI. The respective prevalence was significantly lower in nationals from Turkey (22.9%; 95% CI 18.2, 28.2;  $P = 0.0044$ ), Serbia (22.4%; 95% CI 17.4, 28.2;  $P = 0.0046$ ), Kosovo (18.3%; 95% CI 13.7, 24.0;  $P = 0.0000$ ) and Italy (23.5%; 95% CI 18.5, 29.4;  $P = 0.0166$ ). In contrast, the prevalence of recommended FVI of German (30.4%; 95% CI 24.5, 37.1;  $P = 0.9661$ ) and Portuguese (28.2%; 95% CI 23.7, 33.2;  $P = 0.4029$ ) nationals did not differ significantly from that of Swiss nationals.

The proportion of Swiss nationals with medium FVI amounted to 62.6% (95% CI 61.5, 63.7). The respective proportion was found to be lower in Turkish nationals (52.9%; 95% CI 47.0, 58.8;  $P = 0.0015$ ) and nationals

**Table 2** Population estimates of fruit and vegetable consumption of participants aged 17–64 years by nationality (2010 Swiss Migrant Health Survey and 2007 Swiss Health Survey 2007)\*

|             | 0–2 servings/d† |      |            | 2–4 servings/d† |      |            | ≥5 servings/d† |      |            |
|-------------|-----------------|------|------------|-----------------|------|------------|----------------|------|------------|
|             | n‡              | %    | 95% CI     | n‡              | %    | 95% CI‡    | n‡             | %    | 95% CI     |
| Portugal    | 14 247          | 9.1  | 6.4, 12.9  | 97 853          | 62.7 | 57.4, 67.7 | 44 007         | 28.2 | 23.7, 33.2 |
| Turkey      | 12 698          | 24.2 | 19.6, 29.5 | 27 727          | 52.9 | 47.0, 58.8 | 11 956         | 22.9 | 18.2, 28.2 |
| Serbia      | 4060            | 10.5 | 7.1, 15.3  | 25 950          | 67.1 | 60.6, 73.1 | 8639           | 22.4 | 17.4, 28.2 |
| Kosovo      | 27 328          | 32.3 | 26.5, 38.8 | 41 750          | 49.4 | 42.8, 56.0 | 15 459         | 18.3 | 13.7, 24.0 |
| Germany     | 9593            | 6.0  | 3.8, 9.3   | 101 542         | 63.6 | 56.9, 69.8 | 48 575         | 30.4 | 24.5, 37.1 |
| Italy       | 16 668          | 10.0 | 6.9, 14.4  | 110 581         | 66.5 | 60.1, 72.3 | 39 055         | 23.5 | 18.5, 29.4 |
| Switzerland | 256 372         | 7.1  | 6.5, 7.7   | 2 262 312       | 62.6 | 61.5, 63.7 | 1 093 676      | 30.3 | 29.2, 31.3 |

\*Data were weighted using the weights of the Swiss Migrant Health Survey/Swiss Health Survey.

†One serving corresponds to approximately 120 g. In the case of juice, one serving corresponds to a medium size glass, approximately 150 ml.

‡Estimated number of participants in the population.

from Kosovo (49.4%; 95% CI 42.8, 56.0;  $P=0.0001$ ), whereas the proportion of Swiss nationals with medium FVI was not different from nationals from Portugal (62.7%; 95% CI 57.4, 67.7;  $P=0.9832$ ), Serbia (67.1%; 95% CI 60.6, 73.1;  $P=0.1637$ ), Germany (63.6%; 95% CI 56.9, 69.8;  $P=0.7768$ ) and Italy (66.5%; 95% CI 60.1, 72.3;  $P=0.2236$ ).

Low FVI was more common in nationals from Turkey (24.2%; 95% CI 19.6, 29.5;  $P=0.0000$ ) and Kosovo (32.3%; 95% CI 26.5, 38.8;  $P=0.0000$ ) than in Swiss nationals (7.1%; 95% CI 6.5, 7.7). In contrast, the proportion of Swiss nationals with low FVI did not differ from Portuguese (9.1%; 95% CI 6.4, 12.9;  $P=0.2211$ ), Serbian (10.5%; 95% CI 7.1, 15.3;  $P=0.1052$ ), German (6.0%; 95% CI 3.8, 9.3;  $P=0.4339$ ) and Italian (10.0%; 95% CI 6.9, 14.4) nationals.

Multivariate analysis adjusting for age, gender, SES and dwelling zone generally confirmed these initial results (Table 3). Compared with Swiss nationals, the relative risk of low FVI *v.* recommended FVI was higher in Turkish nationals (RRR = 2.92, 95% CI 1.91, 4.48;  $P=0.0000$ ) and Kosovo nationals (RRR = 4.76, 95% CI 3.01, 7.55;  $P=0.0000$ ). The respective relative risks of Portuguese (RRR = 0.70, 95% CI 0.42, 1.17;  $P=0.1750$ ), Serbian (RRR = 1.42, 95% CI 0.82, 2.46;  $P=0.2140$ ), German (RRR = 0.87, 95% CI 0.51, 1.50;  $P=0.6180$ ) and Italian (RRR = 1.32, 95% CI 0.80, 2.18;  $P=0.2740$ ) nationals were not significantly different from the Swiss reference group.

Migrants from different nationalities and Swiss nationals showed similar relative risks of medium FVI *v.* recommended FVI; none of the nation-specific RRR attained statistical significance.

The relative risk of low FVI decreased with age (RRR = 0.98, 95% CI 0.98, 0.99;  $P=0.0000$ ). That is, older participants were more likely to consume the recommended five portions daily. Similarly, women were more likely to eat greater amounts of fruits and vegetables than men. Correspondingly, women exhibited a lower risk for low or medium FVI *v.* recommended FVI (RRR = 0.22, 95% CI 0.18, 0.26;  $P=0.0000$  and RRR = 0.41, 95% CI 0.37, 0.45;  $P=0.0000$ , respectively). Also, participants

with secondary education or a university degree were more likely to consume greater amounts of fruits and vegetables than those with a basic education (secondary education: RRR = 0.47, 95% CI 0.35, 0.62;  $P=0.0000$  and RRR = 0.75, 95% CI 0.62, 0.90;  $P=0.0020$  for low and medium FVI, respectively, *v.* recommended FVI; university degree: RRR = 0.27, 95% CI 0.19, 0.37;  $P=0.0000$  and RRR = 0.56, 95% CI 0.46, 0.69;  $P=0.0000$  for low and medium FVI, respectively, *v.* recommended FVI). Economically active participants were slightly more likely to have a higher FVI than those who were not economically active (medium FVI: RRR = 1.19, 95% CI 1.05, 1.35;  $P=0.0050$ ; low FVI: NS). Finally, neither housing situation nor the specific dwelling zone was significantly associated with low or medium FVI *v.* recommended FVI.

Several studies show that migrants often adopt the dietary practices of the host country<sup>(30,36–38)</sup>. Consequently, fruit and vegetable consumption of migrants in Switzerland may also be influenced by dietary acculturation. In order to control for potential acculturation effects, length of time in Switzerland (years) was added as a covariate to the model previously discussed and the model was re-estimated using migrant data only. However, length of time in Switzerland had no statistically significant association with FVI (results not shown).

## Discussion

So far, population-based studies on the fruit and vegetable consumption among migrants in Switzerland are rare and have been based mainly on data of the SHS<sup>(39)</sup>. However, the SHS data have limitations with regard to the study of migrants. First, interviews are carried out only in German, French and Italian. Second, the sampling process does not include any migrant-specific characteristics, e.g. the country of origin. Consequently, the SHS data potentially favour well-integrated, well-educated and well-assimilated migrants and potentially omit vulnerable groups of migrants. Furthermore, the sample size for specific groups of migrants, e.g. Turkish migrants, tends to be very small.



**Table 3** Multinomial regression analysis of factors associated with daily fruit and vegetable consumption, participants aged 17–64 years (2010 Swiss Migrant Health Survey and 2007 Swiss Health Survey)\*

| <i>n</i> 14 637; base outcome $\geq 5$ servings/d† | RRR  | <i>P</i> value | 95 % CI    |
|--|------|----------------|------------|
| 0–2 servings/d (low FVI)†                          |      |                |            |
| Nationality (ref. = Switzerland)                   |      |                |            |
| Portugal   | 0.70 | 0.1750         | 0.42, 1.17 |
| Turkey   | 2.92 | 0.0000         | 1.91, 4.48 |
| Serbia   | 1.42 | 0.2140         | 0.82, 2.46 |
| Kosovo   | 4.76 | 0.0000         | 3.01, 7.55 |
| Germany  | 0.87 | 0.6180         | 0.51, 1.50 |
| Italy  | 1.32 | 0.2740         | 0.80, 2.18 |
| Age (years)  | 0.98 | 0.0000         | 0.98, 0.99 |
| Female (ref. = male)                               | 0.22 | 0.0000         | 0.18, 0.26 |
| Education (ref. = basic)                           |      |                |            |
| Secondary  | 0.47 | 0.0000         | 0.35, 0.62 |
| University   | 0.27 | 0.0000         | 0.19, 0.37 |
| Economically active (ref. = no)                    | 1.09 | 0.4200         | 0.88, 1.36 |
| Housing situation (rooms/person)                   | 1.09 | 0.0680         | 0.99, 1.20 |
| Rural dweller‡ (ref. = urban dweller)              | 0.91 | 0.3450         | 0.75, 1.10 |
| 2–4 servings/d (medium FVI)†                       |      |                |            |
| Nationality (ref. = Switzerland)                   |      |                |            |
| Portugal   | 0.80 | 0.1090         | 0.61, 1.05 |
| Turkey   | 0.96 | 0.7970         | 0.69, 1.33 |
| Serbia   | 1.28 | 0.1670         | 0.90, 1.82 |
| Kosovo   | 1.10 | 0.6390         | 0.74, 1.64 |
| Germany  | 1.02 | 0.8910         | 0.75, 1.40 |
| Italy  | 1.15 | 0.3980         | 0.83, 1.60 |
| Age (years)  | 1.00 | 0.4830         | 0.99, 1.00 |
| Female (ref. = male)                               | 0.41 | 0.0000         | 0.37, 0.45 |
| Education (ref. = basic)                           |      |                |            |
| Secondary  | 0.75 | 0.0020         | 0.62, 0.90 |
| University   | 0.56 | 0.0000         | 0.46, 0.69 |
| Economically active (ref. = no)                    | 1.19 | 0.0050         | 1.05, 1.35 |
| Housing situation (rooms/person)                   | 0.99 | 0.6150         | 0.94, 1.04 |
| Rural dweller‡ (ref. = urban dweller)              | 0.97 | 0.5410         | 0.87, 1.08 |

RRR, relative risk ratio; ref., referent category.

\*Data were weighted using the weights of the Swiss Migrant Health Survey/Swiss Health Survey.

†One serving corresponds to approximately 120 g. In the case of juice, one serving corresponds to a medium size glass, approximately 150 ml.

‡Classification according to the Swiss Federal Statistical Office<sup>(61)</sup>. Urban areas include isolated cities ( $\geq 10\,000$  inhabitants) and urban agglomerations ( $\geq 20\,000$  inhabitants).

To our knowledge, the present study is the first which uses the 2010 SMHS data to assess fruit and vegetable consumption among migrants and hence to use a survey that has been specially designed to collect public-health-related data on migrants in Switzerland. Since all SMHS interviews were conducted in the participants' respective native languages, selection bias due to insufficient language skills has been mitigated.

Overall, the proportion of participants who ate five or more servings of fruit and vegetables daily was below one-third in all study groups. The highest rate of recommended FVI was little more than 30 % (German and Swiss nationals); the lowest rate amounted to little more than 18 % (Kosovo nationals). Hence, fruit and vegetable promotion initiatives should continue to address the population of Switzerland at large in order to increase fruit and vegetable consumption. Our results further suggest that some migrant groups are at particular risk of low daily fruit and vegetable consumption. For migrants from Turkey and Kosovo relative to Swiss nationals, the relative risk of low FVI *v.* recommended FVI was substantially higher. In contrast, the respective relative risk for German, Portuguese, Serbian and Italian nationals did

not significantly differ from Swiss nationals. In sum, substantial differences in the relative risk for low FVI *v.* recommended FVI existed between Swiss nationals and migrants from Turkey and Kosovo, and these differences cannot be attributed to age, gender, SES or dwelling zone since we adjusted for these factors.

Previous studies reported that women and older age cohorts consume fruit and vegetables more often than men and younger age cohorts; and that participants with a higher level of education tend to consume more fruit and vegetables than those with a low level of education<sup>(15,16,25,40,41)</sup>. Generally, our findings correspond to the results of other studies. However, an increase in age by 1 year only reduced the relative risk for low FVI *v.* recommended FVI but did not significantly reduce the relative risk for low FVI *v.* medium FVI in our study. Secondary and university education relative to basic education substantially reduced the risk of both low FVI and medium FVI *v.* recommended FVI. With regard to sociodemographic factors and SES, these findings suggest that health promotion programmes should specifically address younger age cohorts, the male population and people with low education level.

### **Limitations of the study**

The present study has several limitations inherent to all FFQ. First, reporting the amount of food consumption is a difficult cognitive task<sup>(42)</sup>. Although the SMHS and SHS questions on FVI included guidelines on size by specifying the weight of one serving (120 g of fruit/vegetables or one medium glass of fruit/vegetable juice), it remains unclear to what extent participants were able to adequately assess the size and weight of food consumed. Second, recalling the average servings of fruit and vegetables consumed each day is also a difficult task. Memory can be quite unreliable or may be influenced by more recent intakes of fruit and vegetables. Third, social desirability may be an issue. Participants may over-report their daily fruit and vegetable consumption because high intake is promoted as a healthy habit. Finally, questions on fruit and vegetables could be culture-sensitive<sup>(43)</sup>, i.e. the concepts of fruit and vegetables may be different or there may be systematic covariations of cultural background and the potential sources of bias mentioned above. More specifically, fruit and vegetables in mixed dishes could not have been considered by some individuals. The European Prospective Investigation into Cancer and Nutrition (EPIC) showed that the intake of vegetables from mixed vegetable dishes varies substantially by country (12–54%)<sup>(42,44)</sup> and a review of brief fruit and vegetable surveys concluded that inclusion of the consumption of mixed vegetable dishes may enhance the validity of the instruments<sup>(45)</sup>. Several validation studies came to the conclusion that FFQ tend to overestimate the mean intake as compared with repeated 24 h dietary recalls, which served as the reference method for assessing intake<sup>(46,47)</sup>. These potential biases suggest that the present results should be interpreted with caution. However, although FFQ may be affected by scaling biases and random error when estimating absolute FVI, they seem to be valid as means of ranking participants by level of FVI. Finally, it is also plausible that mixed dishes, where the major components are fruit or vegetables, are considered when participants report their consumption in FFQ<sup>(42)</sup>.

### **Potential interventions**

Eating behaviour is highly complex and has been described as resulting from the interplay of individual motivation, ability and environmental factors<sup>(48)</sup>. So far, the reasons why Turks and Kosovans have a higher risk of low FVI are unclear and more research is needed. However, we assume that limited access to healthy food in general is not an issue in Switzerland (physical environment). A dense network of supermarkets and local grocers offers fresh fruit and vegetables at reasonable prices. It is also well known that energy-dense diets are associated with lower diet costs<sup>(49,50)</sup>. But fruit and vegetables are generally affordable for those with small household budgets<sup>(15)</sup> (economic environment) and a major supermarket chain, which supports the Five a Day campaign of the Swiss Federal Office of Health,

regularly makes special offers on fruit and vegetables. Moreover, it seems unlikely that migrants from Turkey and the Kosovo are less aware of FVI than other migrant groups or native Swiss because information and materials are available in foreign languages. However, diet-related public health initiatives which address migrants specifically do not exist to date. Since neither awareness nor the physical or economic environment appears to be a barrier specific to migrants from Turkey and Kosovo, we propose that nutrition education initiatives embedded in migrant cultural clubs may be a promising approach to increase fruit and vegetable consumption. These clubs could serve as a basis for peer health educators who offer cookery courses, food tasting and other activities which revive the healthy cooking traditions of Turkey and Kosovo. Food tasting and cookery courses, in conjunction with the proposed social setting, target different but complementing determinants of FVI which are now discussed briefly.

First, there is evidence that food preferences can be learned<sup>(51–55)</sup>. The opportunity to repeatedly taste traditional and novel fruit and vegetable dishes can increase the liking for these dishes. Hence food tastings can help to change food preferences and can increase the motivation to consume more fruit and vegetables. Second, several studies that systematically review the determinants of FVI show that self-efficacy, i.e. people's belief in their ability to succeed in certain situations<sup>(56)</sup>, and nutritional knowledge are positively associated with FVI<sup>(48,57–59)</sup>. Cookery courses can increase practical knowledge on how to prepare novel fruit and vegetable dishes and healthier variations of traditional dishes (healthy alternatives). Similarly, they can increase knowledge on recommended intake levels and awareness of personal intake. Cookery courses help to enable voluntary dietary change by enhancing people's ability, i.e. skills and capabilities. Third, food tasting and cookery courses take place in migrant cultural clubs. The latter can be considered a micro-environmental setting of the sociocultural environment, which refers to the migrant community's attitudes, beliefs and values related to food and physical activity<sup>(60)</sup>. Food-related activities within these micro-environmental settings may not only change people's motivation and ability, but may also help to develop and foster new dietary norms and cooking traditions when people start to incorporate the new dietary practices into their everyday life. Moreover, peer social networks may help to further diffuse new dietary practices into the broader sociocultural environment when families, friends and neighbours are regularly confronted with healthy fruit and vegetable dishes.

### **Conclusions**

In summary, the proportion of participants who adhered to the recommended fruit and vegetable consumption was below one-third in all study populations. Migrants

from Turkey and Kosovo relative to Swiss nationals are at particular risk of low daily fruit and vegetable consumption relative to the recommended daily intake. Initiatives for the promotion of fruit and vegetable consumption should continue to address the population at large. At the same time, programmes that are tailored to the specific needs of migrants from Turkey and Kosovo should be considered.

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